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ABSTRACT

The Learning Style Profile (LSP), developed in four phases from the fall of 1983 to early 1986, identifies perceptual responses, cognitive skills, study preferences, and instructional preferences. This study assesses the LSP Simultaneous Processing Skill subscale, which is modeled after the work of the Russian neuropsychologist, A. R. Luria. Simultaneous processing is the integration of separate elements into a whole. Its essential characteristic is that an entire system is grasped at once. Initial development of the subscale involved selection of six gestalt closure items from a set of 50 developed by C. M. Mooney (1956). Various combinations of items in sets of six were administered to successive groups of elementary and secondary school students, and a subscale of five items was finally retained. In general, factor analysis demonstrated poor reliability, and the Mooney items were dropped. Thirteen new simultaneous subscale items were prepared from computer-generated abstract forms created on a five-pen, programmed plotter. Items were also adapted from three simultaneous subscales of the Kaufman Assessment Battery for Children to serve as a standard measures to evaluate the trial items. Factor analysis of results of administration of the subscale to 1,545 high school students indicated that the reliability and consistency of the subscale are excellent. Two sample test items and one data table are included. (TJH)

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DEVELOPMENT OF A NEW SIMULTANEOUS PROCESSING SCALE

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DEVELOPMENT OF A NEW SIMULTANEOUS PROCESSING SCALE

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The National Association of Secondary School Principals (NASSP) has sponsored research and development activities for educational restructuring since the mid 1950's. Early efforts concentrated on holistic approaches to change, individualized programs, collaborative organizational structures, and continuous progress education (Trump and Baynham, 1961; Trump, 1977). Later initiatives emphasized personalized education, diagnostic-prescriptive strategies, and improving the school learning environment (Keefe, 1984, 1989a; Keefe, Kelley and Miller, 1985; Keefe, 1989b). A specific area of focus for the past ten years has been student learning style.

The Association undertook, in 1979, the cosponsorship of a National Learning Style Network with St. John's University of New York. In 1981, a major conference sponsored by the network brought together many of the leading persons in the field to discuss and exchange information on student learning style and brain behavior. NASSP issued selected papers from the conference in the publication, Student Learning Styles and Brain Behavior: Programs, Instrumentation, Research (1982).

Shortly after the conference, the Association formed a national task force on learning styles composed of researchers and practitioners with diversified interests in the field. The goal of the task force was to study the field in depth, evaluate current assessment technology, formulate a conceptual and psychometric model, and develop state-of-the-art instrumentation.

The task force reviewed a large number of cognitive controls, learning styles, and brain behavior characteristics and reached consensus on a multidimensional view, with "learning style" as the umbrella

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concept. This view recognized three broad dimensions of style -- cognitive, affective, and environmental.

In this paradigm, cognitive styles are viewed as processes and skills that are prerequisite to learning itself. These cognitive skills, in turn, are influenced by various affective and environmental preferences that the individual brings to learning. The gestalt of cognitive, affective, and environmental elements is what we call learning style.

The NASSP Task Force defined learning style as "the composite of characteristic cognitive, affective, and physiological factors that serve as relatively stable indicators of how a learner perceives, interacts with, and responds to the learning environment. It is demonstrated in that pattern of behavior and performance by which an individual approaches educational experiences. Its basis lies in the structure of neural organization and personality which boths molds and is molded by human development and the learning experiences of home, school, and society." (Keefe & Languis, 1983.) Learning style is a complexus of related characteristics in which the whole is greater than its parts. The learning style construct combines internal and external operations that are derived from the individual's neurobiology, personality, and development and that are reflected in learner behavior.

The Learning Style Profile (LSP: Keefe & Monk, 1986) was developed in four phases from the fall of 1983 to early 1986. The Learning Styles Task Force first identified and produced position papers on the most defensible elements of learning style. Extensive use was made of exploratory and confirmatory factor analysis in the field testing of the instrument to support concepts and items with strong factor loading and to exclude those that did not. Factor analysis of the Learning Style Profile identified and helped to purify 24 relatively independent scales

that assess elements of learning style. Higher order analyses identified four second-order factors which were labeled Perceptual Response, Cognitive Skill, Study Preference, and Instructional Preference. This analysis supported the constructual validity and consistency of related variables on the Profile. It also suggested a new research model of learning style:

1. Perceptual Responses - Three initial responses to information (visual, emotive, auditory).
2. Cognitive Skills - Eight information processing elements (sequential processing, simultaneous processing, discrimination, analytic, spatial, memory, verbal-spatial).
3. Study Preferences - Six elements (mobility, posture, persistence, sound, afternoon study time, lighting). Evening preference did not load in this analysis but may be thought of conceptually as a study preference.
4. Instructional Preferences - Six elements (early morning time, late morning time, verbal risk, manipulative, grouping, temperature).

Learning style emerges from this paradigm as an important and stable construct with a meaningful place in contemporary learning theory and practice.

Background

The LSP Simultaneous Processing Skill subscale is modeled after the work of the Russian neuropsychologist, Alexander R. Luria. Simultaneous and successive processes are the basic ways that human beings process information. Simultaneous processing is the integration of separate elements into a whole. Its essential characteristic is that the entire system is grasped at once. Meaning is not dependent on the position (either spatial or temporal) of an experience in the whole. Strength in simultaneous processing indicates a capability to grasp visuospatial

relationships and a skill in relational thinking; i.e., perceiving an overall pattern from the relationships among component parts. Simultaneous processing often has clearcut spatial implications but the task does not have to be spatial in nature. It is important to keep in mind that simultaneous (and successive) processes refer to the ways individuals deal with tasks mentally and not to the nature of the tasks themselves.

Luria (1973) constructed a model of the brain based on more than 40 years of research and clinical work with brain-damaged individuals. His model views the brain as a complete functioning system with three basic blocks or units. The second block (the input unit) includes the occipital, parietal, and temporal lobes of the cortex. These parts of the brain incorporate the structures for visual, auditory, and tactile processing and the association areas in which these sensory inputs are integrated. Luria found that information was processed in the input unit in two qualitatively different ways, which he labeled simultaneous and successive. He reported some evidence that simultaneous processing occurred somewhat more in the right hemisphere and successive processing in the left, but later research has failed to confirm the localization (laterality) of the processes.

Das, Kirby, and Jarman (1979) employed Luria's constructs to formulate a model of intelligence and to build a battery of tests that measure the two kinds of processing. These authors contended that simultaneous and successive processing are cognitive styles, related to such constructs as field dependence-independence, reflectiveness-impulsivity, and conceptual level. The brain organizes experiences into simultaneous groups or successive series. These processing components are always available to individuals and are

unaffected by the nature of the sensory input. The selection of one or both processing styles is assumed to depend on the individual's habitual mode of processing (as determined by genetic or socio-cultural constraints) and on the demands of the task.

In 1983, Alan and Nadeen Kaufman published a nationally normed test of intellectual functioning for children 2 1/2 to 12 1/2 years of age. The Kaufman Assessment Battery for Children (K-ABC) included separate scales for sequential processing (three subtests) and simultaneous processing (seven subtests). The simultaneous subtests relevant to our target population are the following.

- Gestalt Closure: The student names an object or scene pictured only partially in an incomplete drawing.
- Triangles: The student assembles several identical triangles into an abstract pattern to match a model.
- Matrix Analogies: The student selects a picture or geometric shape that best completes a visual analogy.
- Spatial Memory: The student recalls the placement of pictures on a page that is shown only briefly.

Das, Kirby, and Jarman (1979) reported that several tests consistently load on the simultaneous processing scale. They include Raven's Coloured Progressive Matrices (Raven, 1947), Memory for Designs (Graham & Kendall, 1960), Figure Copying (Ilg & Ames, 1964), and Cross Modal Coding (Birch & Belmont, 1964). All these tests present nonverbal, figural tasks requiring the grasping of a spatial or visual gestalt.

Initial Test Development

In preliminary item development, six gestalt closure items were selected from a set of 50 by Craig M. Mooney (1956). These items were modeled after a type first created and used by R. F. Street (1931). The

Mooney items were prepared from illustrated magazine photographs that showed parts of the human head and its features in contrasting highlights and shadows. Hand drawings were made of the highlights or shadows in solid blacks and whites. Both positive and negative versions were produced.

Respondents were asked to integrate the ambiguous elements of these gestalt closure figures and decide if the person was a man, a woman, or a child.

The initial six items of the subscale were placed in two parallel forms and administered to 625 sixth, eighth, tenth, and twelfth grade students. Three of the items were deleted in the first or second passes of exploratory factor analysis. The remaining items loaded equivocally. Sorted factor analysis revealed two factors on the scale. The two items loading highest on the stronger of these factors were retained for subsequent study. Four new items were selected from the set of "Mooney Faces."

A field study of 1,500 students again showed equivocal results. Three factors emerged under sorted factor analysis and the scale evidenced poor internal consistency (-.08). Four items were discarded and two with the most discriminating item statistics were retained for further investigation. Four new items were selected from the original set of 50.

In a field study of 5,000 students, five items loaded at 0.32 or higher on the Simultaneous Processing subscale. The sixth item was deleted in the analysis. The subscale again showed low internal consistency (alpha = .27) but reasonably good item discrimination. The Task Force decided to retain the subscale <u>experimentally</u> in the published version of the Learning Style Profile.

Task Force members hypothesized that the poor reliability of this subscale was probably the result of inadequate response alternatives and not an inherent defect of the items. Field study respondents had been asked to decide whether the closure figures in each item were a man, a woman, or a child. But previous research (Mooney & Ferguson, 1951) had shown that many subjects cannot see anything in the incomplete pictures. The limited response alternatives forced these subjects to guess, with presumptive impact on the reliability of the scale.

The experimental version of the Simultaneous Processing subscale added a fourth response alternative, "Don't know," to each item and respondents were encouraged not to guess. Subsequent analyses of an additional 3,776 subjects, however, showed no real improvement in reliability. The internal consistency of the subscale never rose above .29. The Mooney items were dropped and item development was begun once again.

New Scale Development

Thirteen new simultaneous subscale items were prepared by James Keefe from computer-generated abstract forms created on a five-pen, programmed plotter by Nathan, Robert and Theodore Sussman. At the same time, Marlin Languis adapted items from three simultaneous subscales of the Kaufman Assessment Battery for Children. These items were used as "standard measures" to evaluate the trial items. The K-ABC subscales were Matrix Analogies (16 items), Gestalt Figures (16 items), and Spatial Memory (17 items). The LSP memory subscale composite score was also used as an internal control.

The entire set of items was administered to 313 sixth grade students in the central Ohio area at the end of the 1987-88 school year and the beginning of the 1988-89 school year. The responses were analyzed using

factor analysis with varimax rotation. Eighteen items, exclusively from the new subscale and the Matrix Analogies subscale, loaded together on Factor One (Eigen value=10.4 accounting for 14.8% of the total variance). Varimax rotation separated these items and others as follows:

- Factor one - Items from Matrix Analogies
- Factor two - Items from Spatial Memory
- Factor three - Items from Simultaneous Processing

Many of the new items were very easy and would have too low a ceiling for the LSP, so a second factor analysis was performed on the 28 most difficult items. Only items with 75 percent correct or lower were retained in the second factor analysis.

The second analysis yielded two factors with Eigen values above 2.0, accounting for 19.1 and 8.9 percent of the total variance respectively. Factor one included nine new items and item 16 from the Matrix Analogies subscale. All ten of the items had component loadings of .5 or higher and separated well from factor two which included four items from the Spatial Memory subscale. Factor three included five items from the Gestalt Figures subscale and the LSP Memory subscale composite score. Varimax rotation maintained the same factors and items, and strengthened the separation of the factors.

To evaluate whether there were weak items within the simultaneous factor, a final factor analysis was performed on the nine Simultaneous items and the one item from Matrix Analogies. This analysis strengthened the loading on the items factored. The Matrix Analogies item fell at the bottom of the component loading. New item 2 showed weakness by loading on both factors one and two, and was eliminated from further consideration. Five simultaneous items loaded together, with strong component loadings (.70 to .56) and separated from other factors. New

items 7, 8 and 9 required the student to grasp a complete pattern and sense which part (of several choices) lies within the total; items 10 and 11 asked the respondent to find a part within a total pattern when given the part. (See Figure 1 for sample items.)

A revised definition of simultaneous processing was prepared by Languis based primarily on the loading of simultaneous with matrix analogies items. Matrix analogies are based on analogic reasoning that requires the student to sense (i.e. grasp or -- in Luria's terms -- apprehend) a total pattern in order to complete the analogy. The revised definition of simultaneous processing incorporates the concepts of analogic reasoning and relational thinking; i.e., sensing the overall pattern from the relationships among component parts.

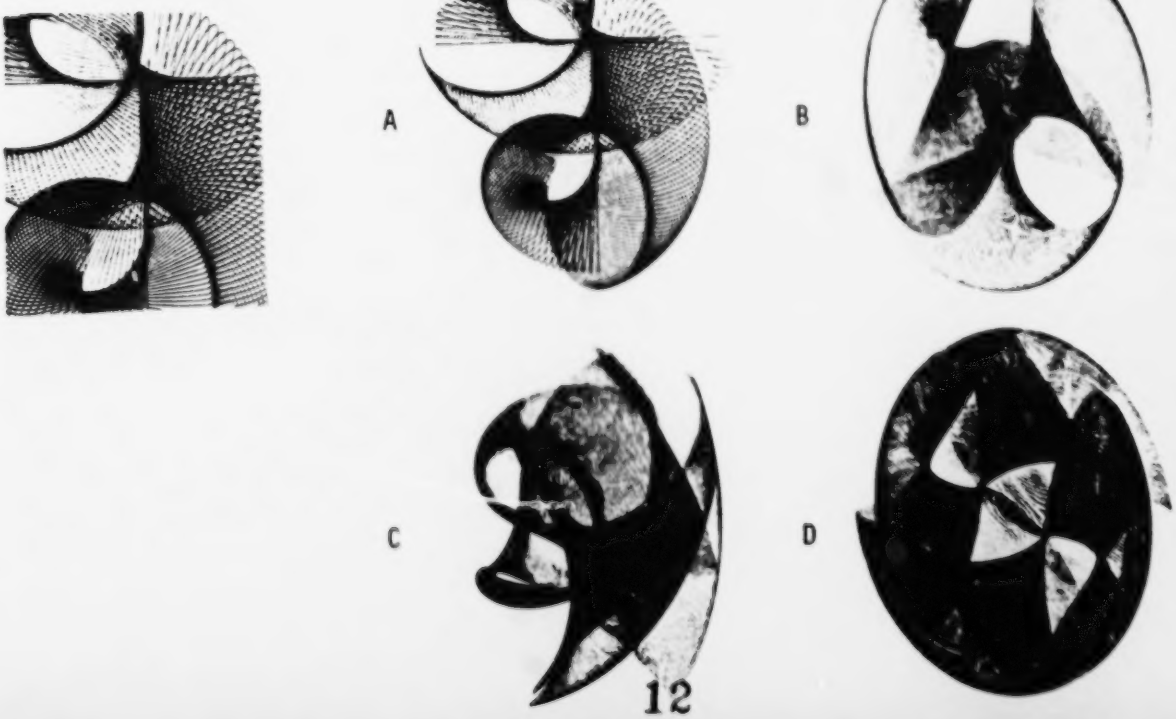
Norming the Simultaneous Subscale

The final step in validating the new subscale was to administer the entire LSP to a more representative sample of students, with the five new simultaneous items replacing the original five closure items. Keefe arranged for several high schools in the mid-Atlantic region to participate in this effort. A total of 1,545 students completed the Learning Style Profile. A factor analysis (with varimax rotation) was performed to evaluate whether the new LSP Simultaneous subscale items would form a discrete factor, separate from the 23 other LSP subscales. All five of the new Simultaneous Skill subscale items clustered together, with a mean factor loading of .83, accounting for 24% of the variance. No other items loaded strongly with the simultaneous items. The results of the factor analysis showed that the new items constituted a very strong and independent subscale.

Figure 1. Sample Items

Look at each form below. Then decide which <u>one</u> of the four parts to each question actually comes from that form. The parts are FACING THE SAME WAY as the form, but are larger. Mark the letter of your choice on your answer sheet.

In these questions, a <u>part</u> of a form is followed by four complete forms. Decide which complete form actually matches the part. The part is FACING THE SAME WAY as the complete forms, but is larger. Mark the letter of your choice on your answer sheet.



The analysis also yielded a Cronbach coefficient alpha value of .858 for the five items. The internal consistency of the new subscale also appears to be excellent.

Graded norms were prepared by Rhonda Roberts as part of a related project--for the total sample, males and females. The ceiling on the subscale remains somewhat low, but discrimination is adequate for a first-level diagnostic instrument, and skill is modestly correlated with developmental level (see Attachment A).

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Attachment A

NASSP LEARNING STYLE PROFILE

Simultaneous Processing Skill Subscale

NORMATIVE TABLE

GRADE	SEX	(n)	MEAN	STANDARD DEVIATION
0	0	1543	4.2450	1.1630
0	1	753	4.2420	1.2030
0	2	785	4.2500	1.1250
6	0	218	3.9680	1.3420
6	1	111	3.9010	1.4140
6	2	107	4.0370	1.2660
7	0	214	4.0050	1.2690
7	1	119	4.0080	1.3120
7	2	94	3.9890	1.2230
8	0	195	4.2150	1.1330
8	1	92	4.4020	0.9150
8	2	103	4.0490	1.2790
9	0	277	4.3180	1.1670
9	1	135	4.3040	1.1920
9	2	142	4.3310	1.1470
10	0	230	4.4220	1.0150
10	1	124	4.5000	1.0320
10	2	105	4.3430	0.9890
11	0	212	4.3680	1.0330
11	1	90	4.3330	1.0910
11	2	121	4.4050	0.9880
12	0	194	4.4020	1.0640
12	1	82	4.2680	1.2670
12	2	112	4.5000	0.8800

Key: 0 = Total sample
1 = Males
2 = Females